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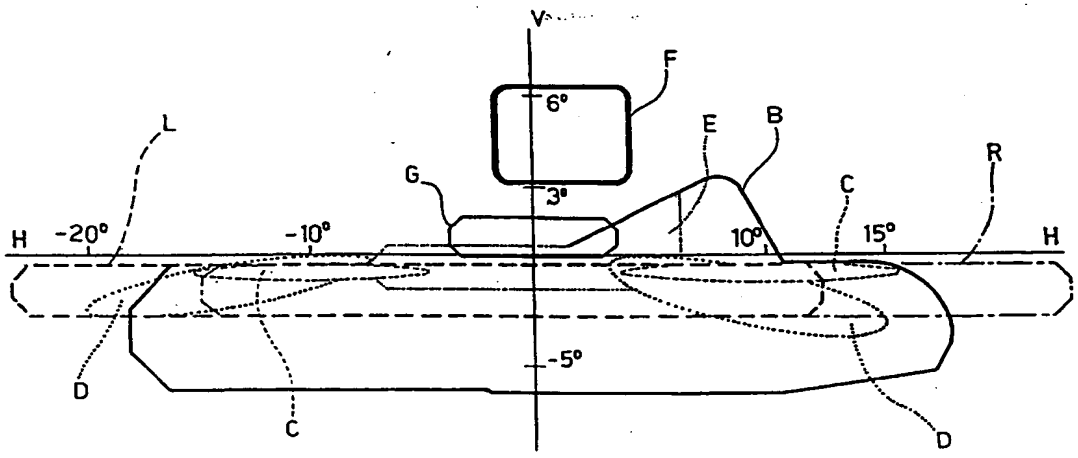
(54) Double headlamp adaptive device for motor-vehicles, with microlens matrices

(57) A double headlamp adaptive lighting device for motor-vehicles, comprises a first headlamp (3) to generate a predetermined basic light beam and a second headlamp (4) having a pair of microlens matrices (11, 12) movable relative to each other so as to be able to select a plurality of different additional beams which are added to the basic beam to generate different total beams.

FIG. 5



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Description

[0001] The present invention relates to a lighting device for motor-vehicles, of the type comprising a first and a second headlamp arranged side-by-side, each comprising a light source constituted by an incandescence lamp and a reflector associated with said lamp.

[0002] In particular, the invention relates to a lighting device of adaptive type, i.e. adapted to generate a light beam at the output whose pattern can be varied depending upon the travel condition of the motor-vehicle (steering angle, speed, etc.) and the ambient and light conditions, as well as the type of road on which the vehicle travels.

[0003] The object of the present invention is that of providing an adaptive lighting device which on one hand is able to provide on optimized pattern in any condition of use and on the other hand has a structure which is relatively simple, of very reduced dimensions and of relatively low cost.

[0004] In view of achieving this object, the invention provides an adaptive lighting device for motor-vehicles, comprising a first and a second handlamps arranged side-by-side, each including a light source constituted by an incandescence lamp and a reflector associated with said lamp, characterised in that said first headlamp is provided to originate a light beam at the output of the device having a predetermined basic pattern, and in that said second headlamp comprises two microlens matrices which are spaced apart from each other, located in front of the light source and reflector and movable relative to each other along a transverse and/or longitudinal direction with respect to the optical axis of the second headlamp, a first matrix of said matrices having its microlenses arranged according to a pitch which is an integer multiple of the pitch of the microlenses of the second matrix, so that said matrices originate a plurality of additional light beams, which can be selected by relative translation of the matrices, so as to generate a total pattern which is different for each condition of use.

[0005] It is to be noted that a headlamp making use of two microlens matrices movable relative to each other along a direction transverse to the optical axis in order to vary the features of the emitted light beam is disclosed in EP-A-0 738 904. However, according to this known solution, a single headlamp is provided which should be able by itself, through the relative movement of the two microlens matrices, to originate a total beam having a variable pattern depending upon the conditions of use. However, according to the present invention, a pair of headlamps arranged side-by-side is provided. The first headlamp has the task to originate a basic light beam, having a predetermined pattern whereas the second headlamp, which is provided with the pair of microlens matrices movable relative to each other in a transverse and/or longitudinal direction relative to the optical axis of the headlamp, has the task to generate additional light beams, which are added to the basic bean of the first headlamp in order to obtain the required total beam.

[0006] According to a further feature of the invention, the two microlens matrices are provided so that a macroscopic relative movement thereof, in the order of the pitch of the microlenses of the movable matrix, gives rise to a complete change of the generated pattern, whereas a movement of lower length does not change the type of generated additional beam, but only varies its features in terms of direction (by a transverse movement) and vergence (by a longitudinal movement) of the selected beam.

[0007] According to a further advantageous feature, the first matrix is arranged between the light source and the second matrix and has its microlenses distributed on the surface facing towards the source, whereas the second matrix has its microlenses distributed on the surface facing towards the outside of the device. Preferably, on the opposite face of the second matrix prisms are provided. By the term "matrix" as used herein, a plate of transparent material (tipically plastic material) is meant which can be obtained by technological processes of a type known per se, having one face thereof defining the microlens distribution. Tipical dimensions of the microlens matrices, in an actual embodiment, are 120 mm for the first matrix and 120 mm for the second matrix, the pitch of the microlens distribution being 6 mm in the first matrix and 3 mm in the second matrix respectebly.

[0008] The relative movement of the two matrices can be obtained in any known way, for example by means of motor means, which also can be made in any know way, associated with the second matrix.

[0009] According to a further advantageous feature of the invention, electronic control means are preferably provided for controlling the above mentioned motor means, which receive signals from sensor means for sensing the travel and ambient conditions and control the motor means depending upon the above mentioned signals.

[0010] The afore-said sensor means may comprise a sensor for sensing the motor-vehicles steering angle, a speed sensor, a light sensor, a GPS receiver, or also a videocamera located on-board the vehicle and having the function of monitor both the ambient conditions and the type of road on which the motor-vehicle travels. In this manner, the device according to the invention is able to automatically adapt to the features of the beam going out of the device to the conditions of use.

[0011] Further features and advantages of the invention will become apparent from the description which follows with reference to the annexed drawings, given purely by way of non limiting example, in which:

figure 1 is a front diagrammatic view of a lighting device according to the invention which clearly shows the double headlamp arrangement,

figure 2 is a diagrammatic cross-sectional view of the second headlamp of the device according to the invention, which is for generating additional light beams which are added to the basic beam generated by the first headlamp,

figures 3, 4 show a detail at an enlarged scale of the head lamp of figure 2, in two different operating conditions,

figure 5 is a diagram which shows the various light patterns which can be obtained by the device according to the invention, and

figure 6 is a block diagram which shows the principle for controlling the headlamp of figure 2.

[0012] Figure 1 is a diagrammatic front view of a lighting device 1 for motor-vehicles, comprising a supporting structure 2 on which two headlamps 3, 4 are mounted side-by-side.

[0013] The first headlamp 3 is of a conventional type, with a light source constituted by an incadescence lamp 5, such as of the H7 type and a reflector element 9 located at the rear of lamp 8. In the drawings, the details of construction of lamp 8, reflector 9 and the way by which lamp 8 is mounted on reflector 9 are not shown, since by can be of any known type and their deletion from the drawings renders the latter simpler and easier to understand. For the same reason, in figure 2, the supporting structure of the device has not been shown, as also not shown is the transparent element 10, which is provided also for head lamp 4, located at the front and spaced apart with respect to lamp 8.

[0014] As shown in figures 2, and 3, 4, the second headlamp 4 comprises a first and a second microlens matrices 11, 12 which are spaced apart from each other and interposed between lamp 8 and the transparent element (not shown) of the head lamp.

[0015] The first matrix 11 is constituted by a transparent plate of glass or plastic material, which can be produced in any known way, having its surface facing towards source 8 shaped so as to define a matrix distribution of microlens 13, such as spherical, aspherical or cylindrical microlenses. In an actual embodiment, the matrix of microlenses 13 has a transverse dimension in order of 120 mm, the microlenses being distributed with a pitch in the order of 6 mm.

[0016] Also the second matrix 12 is constituted by a plate of transparent plastic material made similarly to plate 11, having its surface facing towards the outside provided with a matrix distribution of microlenses 14 (such as spherical or aspherical or cilindrical microlenses) having a pitch which is an integer submultiple of the pitch of the microlens 13. In the above mentioned actual embodiment, the matrix of microlenses 14 has a transverse dimension in the order of 120 mm, with the microlenses having a pitch of 3 mm.

[0017] The two microlens matrices 11, 12 can be moved relative to each other both in a transverse and a longitudinal direction with respect to the optical axis 4a (figure 2) of the headlamp 4. In the illustrated example, matrix 11 is fixed, whereas matrix 12 can be translated by motor means of any type, such as a linear electric motor. Again, the details of construction of the motor means driving matrix 12, as well as the means for guiding the movement of this matrix are not shown, since they can be made in any known way and also in order to simplify the annexed drawings.

[0018] As already described in the foregoing, the first headlamp 3 is for generating a basic light beam, having a predetermined pattern, whereas the second head lamp 4 is able to selectively generate a plurality of additional different beams, which are added to the basic beam generated by the head lamp 3 in order to obtain a total beam having features which vary depending upon the conditions of use. The selection of the additional light beams is obtained by causing a macroscopic movement, in the order of the pitch of microlenses 14, of the second matrix 12, as shown in figures 3, 4, which relate to two end positions of the second matrix 12. Smaller movements of the matrix 12 are instead used to vary direction and vergence characteristics of a determined selected additional beam. In the preferred embodiment which has been illustrated, the second matrix 12 further has a plurality of prisms 15 on its front face.

[0019] Figure 5 of the annexed drawings shows the pattern which can be obtained by the device according to the invention in a plane orthogonal to the optical axis of each of the headlamps 3, 4 and located at a 25 metres distance from the device. In this figure, axes H and V respectively designate the horizontal and vertical directions, whereas the various lines indicate the profiles of the area illuminated by the device in the different conditions of use. The basic beam generated by headlamp 3 is that which originates the pattern designated by line B, which is of the "low beam" or "cross beam" type, having characteristics which are defined by laws or more specifically by car manufactures. For driving in town, the basic pattern B is added with two separeted areas C, as shown in figure 5, by a suitable selection of the position of the second matrix 12 of the headlamp 4. For driving out of town, the two areas D are activated; whereas pattern E is generated for driving on a highway. If desidered, an over-head lighting pattern F can be originated, for use for example when reading over-head road signals. Area G is instead activated when an upper beam is desired. Areas L and R are activated when driving in a curve to the left or the right, respectively, whereas the sum of the two L and R areas is activated when an anti-fog lighting is required.

Figure 6 is a block diagram which diagrammatically shows the matrix 12 and the motor means 16 for controlling the movementof the matrix. These motor means 16 are controlled by an electronic control unit 17 on the basis of signals 18 which are sent thereto by sensors of any type, such as a sensor of the motor-vehicle steering angle, a speed sensor, a GPS receiver, a sensor of the

ambient and light conditions. Additionally or alternatively, a videocamera can be used arranged on-board the motor-vehicle and able to detect the ambient conditions and the conditions of the road on which the motor-vehicle travels.

[0020] Naturally, while the principle of the invention remains the same, the details of construction and the embodiments may widely vary with respect to what has been described and illustrated purely by way of example, without departing from the scope of the present invention.

[0021] For example, the whole device may be adapted to be tilted, in order to contribute to the orientation of the light beam.

Claims

1. Adaptive lighting device for motor-vehicles, comprising a first and a second headlamps (3, 4) arranged side-by-side, each including a light source (5, 8) constituted by an incandescence lamp, and a reflector (6, 9) associated with said lamp (5, 8), characterised in that said first headlamp (3) is provided to originate a light beam at the output of the device having a predetermined basic pattern, and in that said second headlamp (4) comprises two microlens matrices (11, 12) which are spaced apart from each other, located in front of the light source (8) and reflector (9) and movable relative to each other along a transverse and/or longitudinal direction with respect to the optical axis (4a) of the second headlamp (4), a first matrix (11) of said matrices (11, 12) having its microlenses (13) arranged according to a pitch which is an integer multiple of the pitch of the microlenses (14) of the second matrix (12), so that said matrices (11, 12) originate a plurality of additional light beams, which can be selected by relative translation of the matrices (11, 12), so as to generate a total pattern which is different for each condition of use.

2. Device according to claim 1, characterised in that each of said matrices (1, 2) is constituted by a transparent plate of plastic material, said first matrix (11) being arranged between the light source (8) and the second matrix (12), and having its surface facing towards the source shaped so as to define a matrix distribution of said microlenses (13); said second matrix (12) also being constituted by a plate of transparent material having its surface facing towards the outside shaped so as to define a matrix distribution of said microlenses (14).

3. Device according to claim 2, characterised in that the second matrix (12) has a plurality of prisms (15) on its face opposite to that provided with the microlenses (14).

4. Device according to claim 1, characterised in that said second matrix (12) is able to provide a selection of additional different beams by a macroscopic displacement thereof, in the order of the pitch of its microlenses (14) relative to the first matrix (11), whereas it is able to vary the direction and vergence characteristics of a determined selected additional beam by a displacement thereof through a relatively smaller length with respect to the first matrix (11).

5. Device according to claim 1, characterised in that the relative translation of the two matrices (11, 12) is driven by motor means (16) controlled by an electronic control unit (17) on the basis of signals (18) received from sensor means comprising one or more sensors chosen among: a sensor of the motor-vehicle steering angle, a speed sensor, an ambient light sensor, a GPS receiver, a videocamera.

6. Device according to claim 1, adapted to generate a plurality of different total beams having the patterns shown on the annexed figure 5.

7. Device according to claim 1, characterised in that at least one of the two matrices (11, 12) has spherical microlenses.

8. Device according to claim 1, characterised in that at least one of the two matrices (11, 12) has aspherical microlenses.

9. Device according to claim 1, characterised in that at least of one the two matrices (11, 12) has cylindrical microlenses.

10. Device according to claim 1, characterised in that said device is able to tilt as a whole, so as to give a contribution to the orientation of the light beam.

11. Device according to claim 1, characterised in that the first matrix (11) is made of glass and the second matrix (12) is made of plastics.

FIG. 1

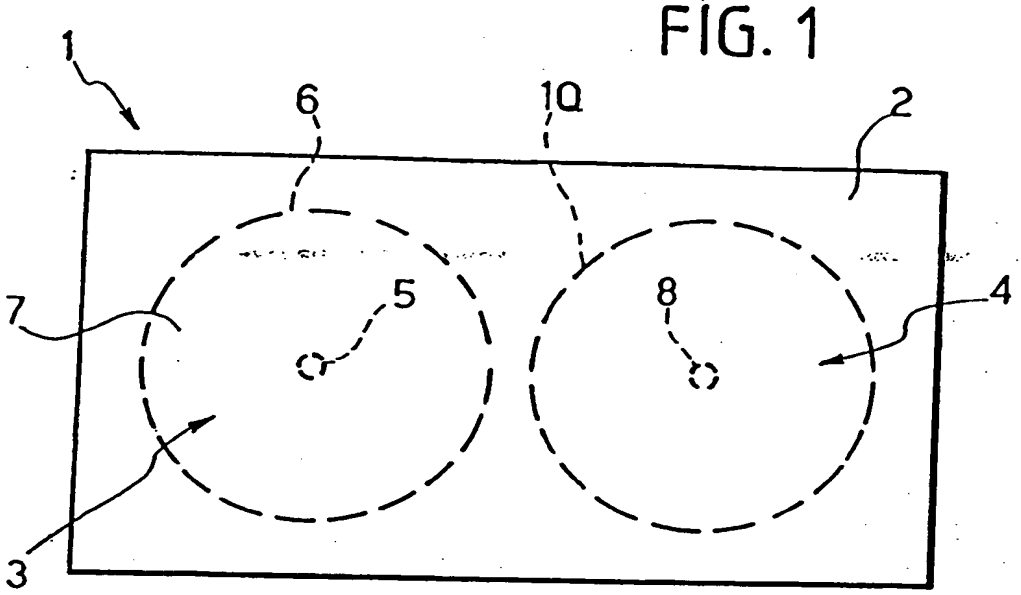


FIG. 2

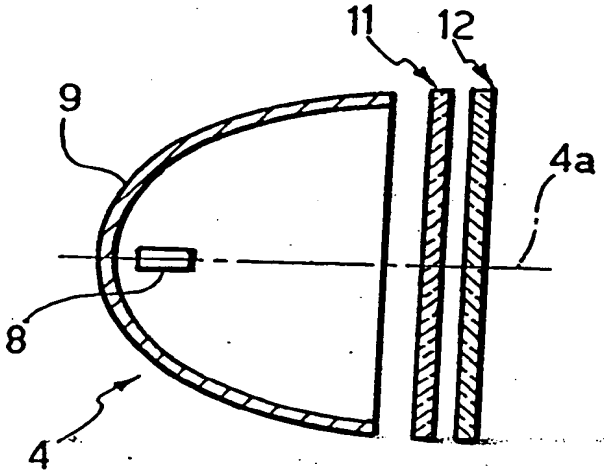


FIG. 6

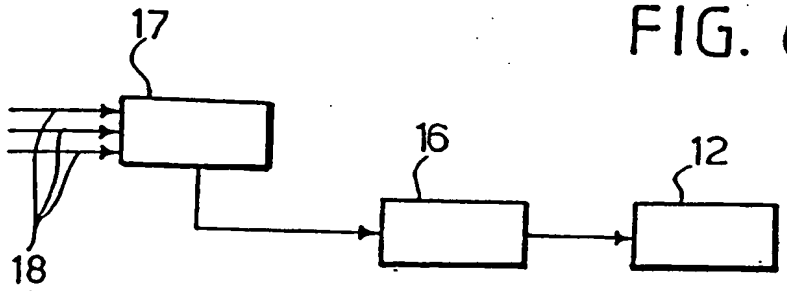


FIG. 4

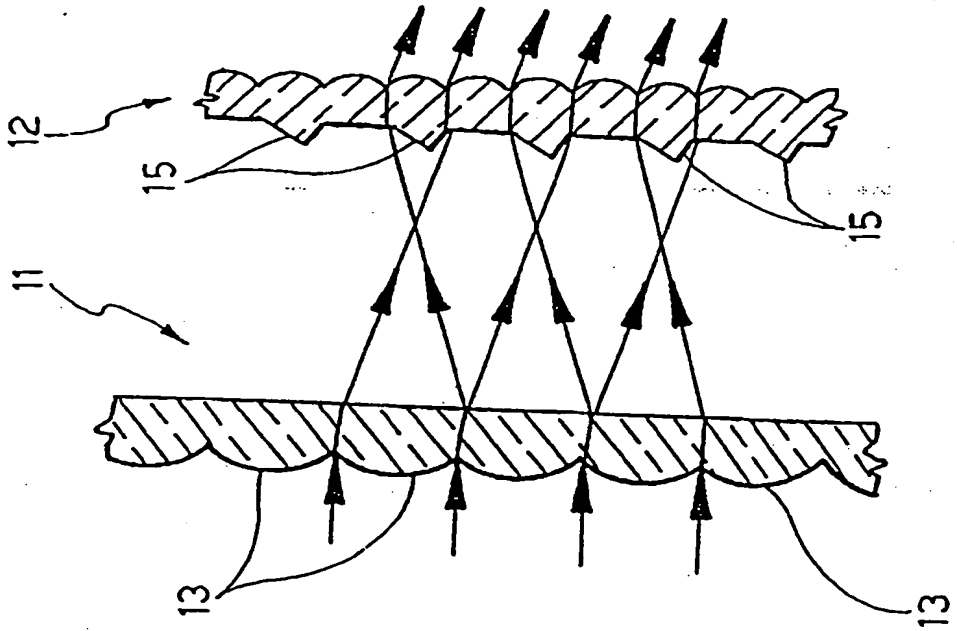
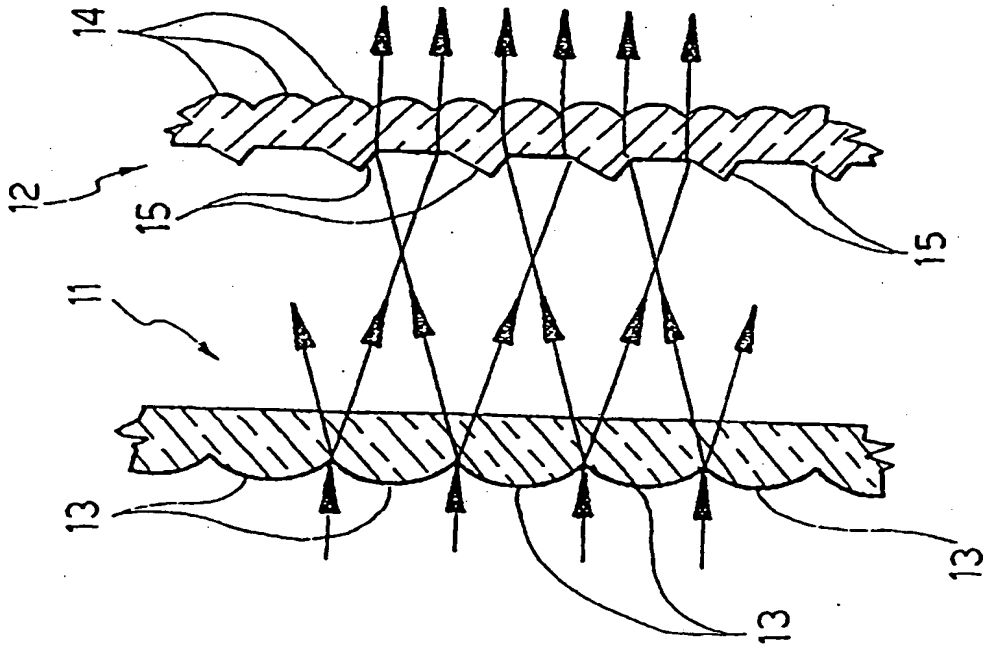


FIG. 3



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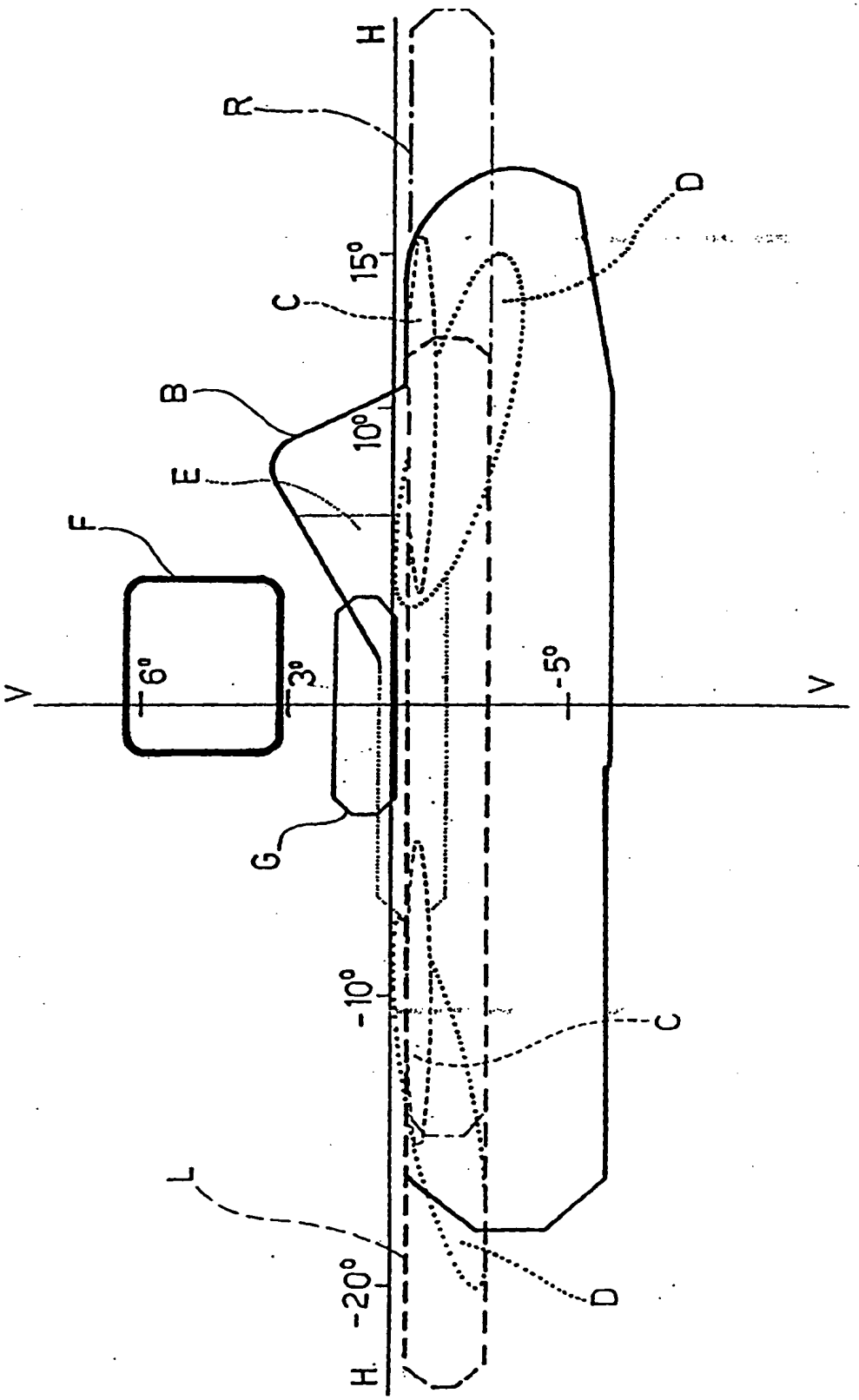

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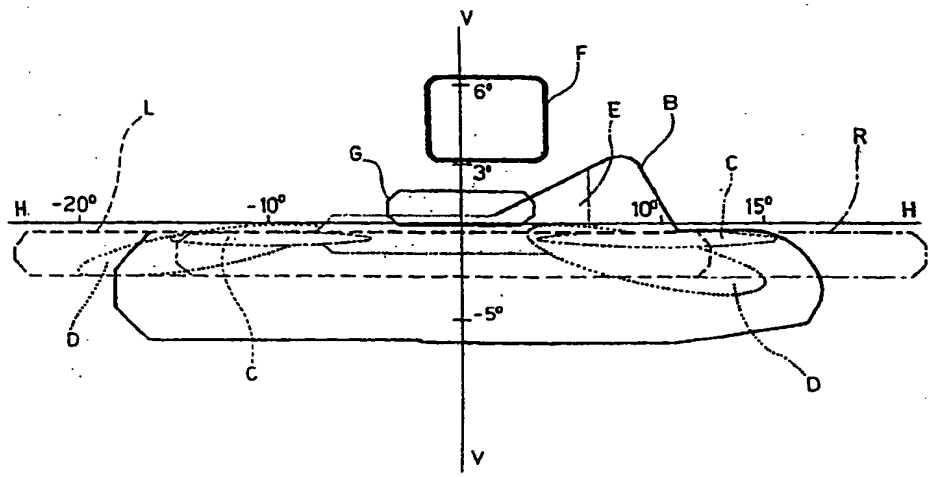
FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 99 12 2136

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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A	DE 43 13 914 A (BOSCH GMBH ROBERT) 3 November 1994 (1994-11-03) * column 7, line 11 - line 40 * * figure 8 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)
F21M
B60Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 July 2001	Clabaut, M

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